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The Story of Dehydration

By B. F. HULSE

(Before the Pan-Pacific Research
Institution.)

"Dehydration" is a very dry subject (it being a drying process), and drying is as old as the hills. It is recorded that King David of Israel accepted raisins in payment of taxes. In 430 B.C., a Babylonian mortgage, the earliest known document of its kind, called for the return of principal and interest in dried fruit. I have a suspicion that the apple of temptation was an old-fashioned dried apple, for it seems to have stuck in Adam's throat. Scientists in late years have tried to qualify the word "dehydration" to mean "the removal of the excess moisture from fruits and vegetables without any loss of food value," but this definition has not yet reached our dictionary.

Dehydration is one form of conservation, and is therefore not popular just at present. This year in California alone, many thousand tons of fruit and vegetables went to waste, but their conservation would have but increased the problem of marketing the rest of the crops at a profit. To the growers, therefore, dehydration is not popular at the present time, so you see that I am assigned a very old, unpopular, dry subject. Therefore I trust you will make due allowances.

I have written several exhaustive theses on this subject, but they are too long and technical for this occasion. I believe that you would not be particularly interested in tracing the evolution of modern dehydration, for the history is replete with failures of practically all of these machines as well as of the companies which were organized to promote them. I shall therefore confine my remarks mainly to the system which is in general use, at least in some modified form, and to the products of this system which gives promise of a partial balance in rations for both

man and the beast upon which man is more or less dependent.

I have been especially requested, however, to preface my remarks by a short résumé of the origin and evolution of this system. This necessarily involves the personal equation, which I fain would omit. However, they seem to think that you would like to know just how any mind could conceive such a crazy idea, and one so at variance with the accepted theories prevailing at that time. The idea was not only pronounced crazy, but absolutely impossible, and the originator crazy as well. This curiosity is probably something like the quest to know what prompted Columbus to conceive that the earth was round, when everyone else believed it to be flat.

In 1913 our commercial attaché in Berlin reported great activity all through Germany in the dehydration of fruits and vegetables. Our Agricultural Department, always anxious to keep abreast of the times and believing that the Germans had probably discovered some new method, were trying to extend their research into the plants. The secrecy maintained about the process made it most difficult for the recognized agents of our government to make this research.

I was therefore asked to make the investigation while posing as a disinterested tourist. I was provided with credentials for research in biology and sanitation, and took pains to have these credentials certified by Emperor William himself, for which I am very thankful, as the possession of these papers, signed by the Kaiser, undoubtedly saved my life when I extended my research into a Zeppelin just prior to the opening of hostilities. On arrival in Germany I soon learned that there were over 2500 dehydrators working night and day, and that

about 1900 of these were operating on Irish potatoes alone. The Germans had certainly dried more potatoes that season than we had raised in the U. S. A. Great warehouses were filled with thousands of tons of this potato flour and dried fruits and vegetables. I found the general system of dehydration no different from ours except perhaps that they did not attempt to dry in the natural state, but macerated or cut the products into very small particles for rapid drying, and that they blanched the product (practically cooking it with live steam) before drying to avoid oxidation. Of course, I could only report as above and that it was clearly evident that Germany was preparing for war. I rushed to France and England with this news, and found them wholly unprepared; so deceived were they by the honied words of the Kaiser that they laughed at my concern, although I had seen trainloads of war material going to the front in Germany and troops being secretly moved at night. The credulity of the French was especially pitiful, for the declaration of war followed within a few days.

Later, in discussing matters with Lord Haldane (the war lord of England), I found that his greatest concern was the problem of getting proper foods for the soldiers at the front. I was offered a commission in the Engineers Corps, but he thought that I could be of more service by returning to California, there to mobilize all possible equipment for the concentration of fruits and vegetables so necessary for the soldiers' rations.

We were able to furnish an enormous quantity of these goods, but being so hastily prepared the quality left much to be desired, and it is not strange that the soldiers have sworn off for life on so-called dehydrated foods. Nearly all of these foods were dehydrated in accordance with the English practice and according to their instructions, which left little room for initiative, but when we entered the war I was asked to make extensive research in this work with the hope of

improving the quality of the food. It was perfectly natural that we should use hot dry air as a means of drying, but I found that this system tended to dry the outside first, thus closing up the pores so that the inner moisture could not escape until the outer cells were shriveled and broken down. This permitted the nutritive portion within the cells to become oxydized in the air. This oxydized surface made an active field for the germination of bacteria and the larvae of insects with which the product was soon infested. Thus I realized that oxygen which was so essential in life and growth was the real menace to open air drying, and immediately began experiments in atmosphere devoid of free oxygen. My first experiment was with carbonic acid gas (CO_2), but this being heavier than air and so readily diffused, was very hard to hold in a dehydrator, so I built a box on the ceiling of a tight basement and placed a circulating belt therein, feeding the product onto this belt through an opening in the floor of the store above. A fan was used to circulate the heated CO_2 in opposite direction to belt travel. The only opening in this basement was through a stair well at the opposite end of the basement, with a window to the outside at the ceiling of this stair well. I then began circulating CO_2 by feeding it into inlet of fan. As the gas was fed into the fan the air in the basement was expelled through the stair well. The discharge from dehydrating box being into the basement at opposite end from stair well, assisted in the process of expelling the air without great loss of gas by diffusion, and this loss was minimized by covering the outlet to atmosphere with miners' gauze through which the unstable gases do not readily pass, while allowing both air and vapor to pass freely. Thus was evolved the first submerged dehydrator in which it was possible to retain the valuable heavier-than-air gases for reheating and recirculation. These gases of greater specific gravity settled to the floor line, from where they were drawn

through a fan, reheated and recirculated while the vapor and air in its passage through basement stratified and rose to the ceiling to be expelled through gauze-covered opening. This experiment proved that we could dehydrate by recirculation without the introduction of any outside air or gas except that which had passed through the burner and therefore was without free oxygen. In fact, we soon discovered that these products of combustion were fully equal to the CO_2 . In a case where secondary combustion was used in connection with kerosene fuel, results seemed to imply their superiority in that they seemed to possess some quality which congealed the juices of the fruits instead of drying them, thus shortening the time required and leaving a heavier, more succulent product. Gases of combustion, when properly rectified, are a clear, odorless and tasteless product, devoid of the quality of smoke—(free carbon), and undoubtedly possess a highly sterilizing quality similar to that disclosed in the process of smoking meat.

Submergence in this gas devoid of free oxygen seemed to kill the harmful bacteria and all larvae of insects. Having no oxydized surface, the dried product is no longer a host for insect larvae and has been kept for years without insect infestation or deterioration in quality.

It was but natural that people condemned this system as based on an impossible hypothesis and dubbed it the smoke system. We had long been taught that it required a certain volume of air to carry off the vapor from a certain quantity of water, and that this air became saturated and would not thereafter absorb more moisture without added heat. This new theory of separating vapor from air was not recognized, and people generally accepted the theory that moisture-laden air was heavier than dry air because it contained water, which we all know is heavier.

My patent attorney refused at first to draw the claim, which stated "that the steam, or vapor, after stratification, passed

off at the top," and the patent office disallowed this claim as an untenable theory until assured that this was an actual accomplishment. They lost sight of the fact that it is not weight, but specific gravity, of the two gases which we were dealing with. That water when transformed to the gas (vapor) expands over 1700 atmospheres and thus its specific gravity becomes less than that of air and will rise, as any one knows who has watched the discharge from the spout of the teakettle. If vapor was of greater specific gravity than air, the clouds would fall on us at once, while they only fall when the vapor is again reduced to the liquid form—water.

The capacity of the gas to retain moisture increases or decreases with the rise and fall of its temperature. Therefore when the greater portion of the vapor is separated by stratification and the gas drawn back from the floor line, reheated and recirculated over the traveling belt laden with the food to be dried, its capacity has been increased, and, therefore, it dried the product. In its passage over the product from the dry to the fresh, it soon becomes saturate, and meeting the cold, fresh product actually condenses a portion of the moisture, thus transferring the latent heat to the product, which is then covered with the moisture of condensation. This tends to open the pores and sweat the inner moisture to the outside, just as a person will become moist and perspire freely in a hot, moist climate; thus this becomes a sweating process, except just at the finishing end, when the reheated gas dries off this moisture which has been sweated to the surface.

You would naturally expect this to be a much slower process, but in one plant which I changed over from an open hot-air drier to this system, the company wrote me a letter stating that "it increased the output of the plant about fourfold, while reducing the fuel cost by two-thirds, and produced a superior quality product, with about one-fifth less bulk reduction," which meant that they had one-fifth more

and a better product from the same weight of fresh material.

The development of this system was accomplished while I was working for the government, during the war, but not one cent of government aid was received or used in the experiment. I did not desire to monopolize the principle under a patent, but without this protection I was unable to get any one to quickly commercialize the process so that the improved products might be available for our soldiers at the front. We therefore made application for letters patent, and I assigned all my right and title to an incorporation, which agreed to begin operations at once. The control of this company fell into the hands of a German who did not seem overanxious to help our soldiers. Therefore, I managed to keep the patent from being issued, although notified that the claims were allowed and patent would be issued on payment of the required fee. The system is, therefore, as free as the air for the use of any and all.

At the opening of the first commercial plant, a celebration was planned and most of the notables on the coast were invited. Although having no financial interest in the plant (as its co-inventor), I was asked to address the gathering and explain the theory of the process. After this ceremony a friend of mine overheard a conversation which probably reflected the general reaction of this theory.

As I remember, the parties mentioned were Hon. Clement Horst addressing the late Luther Burbank, asking what he thought of the theory. Mr. Burbank, pointing to his head with an expression of great sympathy, said: "Just another good man gone wrong—the inventor, like the miner, thinks of one subject until his mind travels in a circle. He fools himself and actually believes the most impossible things." Later in the day, when an excellent quality of raisins began to be delivered from one tunnel and dehydrated sweet potatoes from another, neither product showing any oxidation, the howl went up that there was "hocus-pocus"

somewhere, because although no air was being admitted except the small amount to supply combustion, there was a great draught passing out at the top of the box. One "learned professor" proceeded to measure this discharge and, subtracting that supplied by the burner, was able to tell the assembled multitude just what size fan we must have delivering this air through some concealed duct. When I explained the weight of water being removed per minute and computed its expansion into vapor, it tallied almost exactly with his computation, and the knowing professor faded out.

Having recounted the evolution of this successful system, no doubt you are wondering why there are not more of these plants in operation. In the first place, the initial cost of a dehydrator is considerable, and although this is a most efficient system, yet it requires heat, power and labor for its operation, while in open-air drying the sun does the work, so it is not a case of "let George do it," but, instead, "let old Sol do it." In a very hot, dry climate it is surprising how good the sun-dried product is, but an unseasonable rain may spoil the entire product. A bulletin of our California Agricultural College contends that the added quantity and quality of most dehydrated fruits over that produced by sun drying will pay for the processing. However, that does not supply the machine to the grower, who is already bankrupt. I will recount an incident, or rather two incidents, which present the real difficulty in this country. Some years ago the growers of central California were faced with the loss of a large portion of their grape crop owing to early rains, so the Chamber of Commerce asked me if I would not start a number of dehydrators which were idle and explain the method of operation. On arriving at the plant, I found the walking delegate there to see that we employed only union labor. I was informed that the unit of labor for an operator would be \$5.00 for the first eight hours and \$10.00 for each of the other two shifts, or \$25.00

for the 24 hours, which is necessary in dehydrating. He also wanted \$8.00 and \$16.00, respectively, for an engineer to operate the burner, but I finally induced him to allow the regular attendant to watch the burner, which was automatic in action.

Shortly afterward, my wife and I were attending a fair in Milan, Italy, and noticing samples of beautifully dehydrated fruit and vegetables, we remarked at once that they must have been dehydrated by this process. These proved to be from a plant operating near Turin, the old capital of Italy, so I went down to see the plant and found that it was installed by a man to whom I had furnished plans for an installation at Fresno, Cal. On inquiry I learned that he was paying 16 lire per shift (about equal to \$2.40 per unit of labor per day). Comparing this with \$25.00 in the United States, it is clearly apparent why he chose Italy instead of the United States for his field of operation.

This also illustrates our struggle to maintain in this country a standard of wage and living estimated to be six and one-half times the average of the world. It has thus far been maintained by our tariff wall, but let that fail and we would be submerged as surely as would the people of the Nuuanu Valley had the Nuuanu dam failed at the height of your recent flood.

About the only plants which can operate in the United States are those where the hand labor can be practically eliminated by the use of automatic machinery or where a waste product is being salvaged. You have a concrete instance of the latter in your pineapple industry, in which more than half of the pineapple was formerly a waste. I was informed that it cost the Hawaiian Pineapple Corporation over \$50,000 to dispose of this waste in 1913 and in comparison with their present output this cost would probably have reached at least \$300,000,000 had they not installed a dehydrator, which has successfully transformed this waste

into pineapple bran, a most valuable stock food. This proved a boon to these islands, which were importing the bulk of their stock food. The Islands' total output of bran for the season will reach the enormous quantity of 8,750 tons.

The cost of this process is very small owing to the use of automatic machinery, which makes it possible to deliver this waste by automatic conveyor into one end of a revolving drum, from the other end, of which the finished product is again delivered by conveyor to the sacking chute. The average sale price has been about \$20.00 per ton, but is slightly lower this season as the saturation point of the market seems to have been reached—price and quality considered. It would be preposterous for me to criticize the general practice of these companies, which are recognized as the most highly specialized and successful enterprises in the world, but this particular branch is but a side issue and one which must not fail to function in exact synchronism with their basic operation. Therefore they are not to be criticized for playing the game safely in the installation of this salvage plant, and installing only that which had been proved, even though it might not be of the highest efficiency or reach the limit of perfection in quality of production. Although I assured them of the success of this newer system, they were too far from any of these plants to see the operation, and it was impossible to convince them except that they be shown. Possibly the fear of complication as to royalty may have been a deterrent factor in their not adopting the new system in its entirety at that time. Their ability to operate at temperatures far in excess of that permissible in foods for human consumption greatly reduced the time required, and, therefore, limited their great necessity for the new system for speed of operation. However, as the time seems to have arrived when the food value must be increased or the price reduced to find a further market, no doubt more thought will be given to increasing the quality and

decreasing the cost of production. The principal cost is for fuel for redrying. A dryer in the plant of the Hawaiian Pine used approximately 45,000 cubic feet of air per minute, which is heated to about 1800° F. After passing through the dehydrator it was discharged to atmosphere at approximately 220°, thus the heat required to raise 45,000 cubic feet of air from average temperature of 70 to 220° was wasted during each minute of operation, besides much radiated heat was lost through radiation from the drum of this dehydrator. This loss extended over many years, although I called attention to it on my last visit. The principle of recirculation was then sufficiently established that a duct was installed and the discharge connected to the inlet, thus recirculating and saving this enormous heat loss. The lighter color of the bran is very noticeable, which indicates less oxidation owing to recirculation of the burned gases in place of fresh air. However, as these gases return at high velocity, leaving no chance for stratification except in the separator, full benefit of this principle is not obtained.

In the plant of the Libby Co., the drums being shorter, necessitated discharging the air at approximately 250°, thus entailing a still greater loss.

Spurred by the necessity for greater economy, I prophesy that these plants which are the ultimate of efficiency in most of their operations, will soon house in these machines with insulated walls and draw the return air back through the space surrounding the drum, thus preserving their radiator heat as well as that now being wasted in the air. The slow movement of the return air through the large space will permit of stratification, allowing the vapor air to separate and be discharged at ceiling, while the gases are drawn from the floor line, reheated by mixing with the products from burner, and be recirculated. In this manner the circulating medium would soon become only the burned gases, which have been denuded of free oxygen in burning. There-

fore oxidation of the product would be precluded.

The projection of any organic substance into very hot air causes a sudden expansion of moisture within the cells, which bursts the cell wall and leaves the nutrient and mineral salts open for oxidation and dissipation by the heated air, thus robbing the finished product of considerable weight and its most nutritious portion.

Though very rich in some elements, pineapple bran being made from one portion of the fruit is not a perfectly balanced ration and may not be as readily assimilated as if it contained the entire fruit.

I came to the islands this time with great hopes of establishing a new industry which would provide quantities of valuable food very rich in proteins and mineral salts, which would serve to balance the ration and thus increase the use of pineapple bran.

A great industry has been built up on the mainland in the harvesting and drying of kelp, or seaweed, as a food for both man and beast.

I had done some research in your waters and knew that they were rich in brown algae, which is of the same family as the giant kelp of the Pacific known as *Mascrocystis pyrifera*. I assumed that the deeper benches adjoining these islands would naturally be forested with this plant, which should thrive and grow most rapidly in these warm waters under a tropical sun. I was doomed to disappointment, for research fails to reveal a single trace of this plant—your scientists of whom I have made inquiry even discourage the idea of transplanting this species to this area—claiming that if it would grow here it would be here, as the tides would surely have transported it. Still I am not wholly discouraged and cannot fully subscribe to this theory. I know that it is true that the kelp stipes are carried a long distance by the tides, and that any portion, no matter how small, will continue to grow so long as it is in the sea water, but I also know that none

of these floating portions are capable of reproduction. The organs of reproduction are very near the root, and the fact that it spreads but a few feet from its source is evidence of the difficulty of tide transportation of the reproducing organisms for great distances.

The United States Department of Agriculture has made extensive research on this plant and made attempts at transplanting to the Atlantic coast. I have these bulletins on the coast, but was unable to get them here in time to be of use. My memory is that the experiment was a failure in the North Atlantic, but was successful in the warm waters of the Gulf Stream. Elaborate surveys and maps of the kelp beds were made during the war, and show an area of nearly 500 square miles on the Pacific Coast. This research was carried on primarily to locate a new supply of potash, source of which was shut off during the late war. Millions of dollars were spent in experimental work and much potash produced at a time when it was marketable at \$400 to \$500 per ton for war purposes, but these plants soon closed down under competitive prices. Potash from Germany formerly cost about \$40.00 per ton.

Our attention naturally turned to kelp as a valuable food supply, and we soon found that live stock was, after all, our best means of turning it into fertilizer. We had long known that kelp was rich in the mineral elements which are required for both man and beast, and that they were in a very assimilable form and readily furnished those deficiencies found in much of our diet. The great erosion of the land has undoubtedly dissolved the soluble mineral elements and deposited them in the sea, so we naturally turn to sea food for that which is lacking in food produced from the soil. Plants cannot be expected to extract from the soil that which is not present, nor the animal to extract that which is not present in its food. Likewise, we cannot extract from our food that which it does not contain.

In my close study of anatomy and phy-

icine, I was greatly impressed with that wonderful handiwork of God—the human body. After a most intensive study I came to the conclusion that it was the only perfect mechanism, which, if given proper care and the proper food, could rebuild and perpetuate itself. I was impressed that it was evidently the intent of our Maker that we should be well and happy without recourse to stimulants and poisonous drugs. Sickness and pain could nearly always be traced to some deficiency in our diet or improper care of the body, and I find this theory gaining ground.

Dr. J. W. Turrentine, of the Department of Agriculture, Washington, D. C., has made some valuable research in deficiencies of our foods, and consequently of our bodies. His report on "*Kelp as an Agency for the Control of Goiter*," reprinted in the January, 1925, number of the *Scientific American*, is most interesting, and while it applies particularly to goiter, the principle is equally applicable to other deficiency diseases, so I am taking the liberty of quoting him at some length and would refer you to his digest for further detail. He says (page 31):

"Apparently man's metabolic welfare depends in part on the maintenance of this seemingly insignificant yet actually indispensable store of iodine."

The function of the thyroid gland may best be described in the words of McCarrison, who lists the principal duties of that gland as four in number:

"(1) It governs the growth of all cells, and sustains their functional activity. (2) It controls calcium metabolism. (3) It is a profound katabolic stimulant, facilitating the breaking down of exhausted cells and governing the elimination of the waste products of their disintegration. (4) It exercises a protective antitoxic and immunizing action, defending the body, not only against the toxic products of its own metabolism, but against invasion by disease-producing microorganisms and injury by their products. . . .

"The thyroid gland is to the human

body what the draught is to the fire; nay, more; its iodine, by its chemical interaction with certain unknown constituents of the cells, is the match which kindles it. . . . The thyroid gland is specifically associated in the exercise of its functions with the generative organs. . . . By stimulating the development and growth of the sex organs the thyroid secures through them the progress of mental and physical growth."

LACK OF IODINE IN NORMAL DIET

The modern diet is made up largely of highly refined materials, seeds constituting most of it. These, in their natural state, in addition to materials of great value as sources of energy, contain many of the mineral elements and compounds essential to animal life and growth. But in most cases they are refined to the point where the latter are eliminated. As a result, when used alone, they are not able to sustain life; it has been shown that animals fed on certain of them exclusively perish more quickly than do those entirely without food. The excessive use of refined foods leads to deficiency diseases. Overrefinement in food manufacture deprives us of essential elements which under less artificial conditions would be a natural part of our diet. No automatic method is provided for supplying these materials, of great importance in every case, but of the greatest importance in feeding the young. The diseases of the bones in growing children as a result of deficiencies are well recognized. Less attention is paid to the frailty and inadequacy of the teeth as a result of similar causes.

Together with deficiencies of the many commoner elements, there occurs, of course an even more marked deficiency of iodine. The slight occurrence of iodine in food materials is shown by the elaborate research of Forbes and Beegle as illustrated by the following summary:

The various groups of food materials analyzed, in the order of the increasing frequency of iodine occurrence, are as follows: (1) Nuts; (2) spices, condi-

ments and stimulants; (3) fruits; (4) cereals; (5) hogs, silage and forage crops; (6) garden vegetables and root crops; (7) leguminous seeds; (8) animal products, and (9) manufactured foods and milling and manufacturing by-products. "Among the cereals iodine was found as an uncommon constituent, usually in traces only."

METHOD OF SUPPLYING IODINE TO THE DIET

As a source of iodine for human metabolism it is obvious one must look to the sea, the great storehouse of that essential element, and choose that method of securing the requisite quantity in the manner which most readily coincides with one's already-established dietary habits. Sea foods might well become a more common article of diet, but at the present cost for preservation and transportation do not reach the majority of people. Sea salt is not a commodity at present cheaply obtainable; its wide introduction as a condiment would be of great benefit to the human race. A logical and from many points of view an ideal conveyor of all these essential elements are the kelps, the larger seaweeds of the brown algae group.

COMPOSITION OF KELP

Chemical literature is replete with references to investigations of the composition of kelp. They have been studied from the point of view of their utilization as foods, and as carriers of inorganic salts and iodine. The different species vary in chemical composition, quantitatively rather than qualitatively. Most of the work in America has been devoted to the giant kelp of the Pacific, *Macrocystis pyrifera*, made the basis of the extensive investigations of the United States Department of Agriculture. Its composition is more thoroughly understood perhaps than that of any other sea plant.

The composition of this kelp has been studied to determine its water, organic, inorganic, nitrogen, protein, sugar and fat content. It is tremendously complex, being made up of a great variety of or-

ganic and inorganic compounds, and of organic compounds containing and combined with mineral elements. In organic combination are parts at least of the iodine, the phosphorus and the sulfur. In the plant, all of them are held in varying degrees in colloidal suspension.

The many analyses of *Macrocystis pyrifera*, made in state and federal laboratories, show on the average: Potassium chloride, 22 per cent.; sodium chloride, 10 per cent, and water-insoluble ingredients, 7 per cent. (on the dry basis). Entering into this total of 37 per cent. inorganic material are: Calcium, 4.96 per cent.; magnesium, 2.24 per cent.; sodium, 10.52 per cent.; potassium, 29.46 per cent.; iron and aluminum oxides, 0.43 per cent.; chlorine, 34.93 per cent.; sulfur (calculated to SO_3), 4.44 per cent.; phosphorus (calculated to PO_4), 2.30 per cent. While all the kelps contain iodine, the iodine content of this species is phenomenal. Of 29 samples analyzed for that element, an average content of 0.26 per cent. was shown, with a maximum of 0.41 per cent. and a minimum of 0.17 per cent.

From the foregoing it is evident that this kelp contains the principal ingredients of sea water, and has stored them up within itself in even greater concentration than most of them exist in sea water. This is particularly true of potassium and iodine. It appears, therefore, to be an ideal concentration of the desirable elements of sea water with the relatively marked elimination of the most common and least valuable—common salt.

ADAPTABILITY OF KELP AS A DIET AMENDMENT

As a conveyor to the diet of the essential mineral elements, kelp possesses many ideal characteristics. It is a carrier of iodine of remarkable properties—a high content of iodine, together with a great assortment of other useful elements. The source of raw material is abundant. Methods have now been perfected whereby it may be so processed that its colloidal

constituents remain unimpaired and its mineral content unreduced. When so processed it is a carrier of these elements and compounds in a natural, vegetable colloidal suspension, from which or through which they may be taken up by slow, digestive processes just as they would be if they were made available as natural constituents of usual articles of diet. Being highly concentrated in these, preparations may be made in condensed forms so that the convenience wherewith they may take a variety of forms, suitable for addition to the diets of people of varying ages and dietary habits. It is important that kelp to be used for the control of goiter be employed as a preventive as well as a cure, particularly that it be added to the diet of the young and to all those approaching or experiencing life crises. It is contended by some that its addition to the diet should be made a part of a culinary or dietary routine and not left to chance or the caprices of the memory. On the other hand, the disciplinary and educative advantage to be had from consciously taking as a diet amendment a concentrate of essential elements must not be overlooked. Being abundant, cheap and conveniently acquired, transported and stored, it should be made available for all peoples of all lands. Through its instrumentality, as a carrier of iodine, and other desirable elements, not only goiter, but other diseases depending on related deficiencies may be eradicated.

The present methods of combating goiter by the administration of metallic iodides or thyroxin, leave much to be desired. The administering of iodides, as, for example, dissolved in the drinking water of a school, results in uneven dosage, though rarely in such an excess as to cause symptoms of iodine poisoning. Yet Bircher describes the practice as causing harm and is supported by others in this contention.

What the situation requires is iodine in a form as closely as possible approximating the natural form in which that element is normally taken into the body, in

organic combination, preferably as a constituent of food materials. Salts of iodine radically fail to meet this requirement. Those employed are very soluble and therefore are able to overcome the natural metabolic balance of the body solutions and thus rapidly to force their way into the circulation and out. The situation calls for a food, not a drug.

With a natural food material at hand, the wisdom of resorting to drugs for feeding is open to question. It must be remembered that iodine is administered in goiter, not on account of any physiological action it may have as such. On the contrary, its physiological action—as exhibited by iodism, for example—is exactly what one desires to avoid. It is given merely to furnish raw material to the thyroid wherewith to manufacture essential secretions. The situation demands physiologically inactive iodine, in so far as such is attainable.

Soluble iodine is not necessarily assimilable iodine. And in this connection it may be remarked that while the interconnection between iodine and goiter has been known for a hundred years, no appreciable impression on the progress of the disease has been accomplished by the use of iodides. On the contrary, it appears that goiter is on the increase, a fact attributable to the increased use of refined foods and of surface water for drinking purposes and demands for nervous energy occasioned by our modern social régime.

CURATIVE POWERS OF KELP

This suggested use of kelp, based on a priori considerations, has within recent months been subjected to a rigid clinical demonstration with results so uniformly favorable as to exceed expectation. Under the supervision of skilled endocrinologists, victims of goiter of a variety of involvements have been treated with standardized kelp extracts and with very few, if any, exceptions have responded favorably. Under this treatment heart action and metabolism have been restored to normal, the swelling of the thyroid glands

reduced, nervous disorders have disappeared, and in every case where frequent periods of violent insanity formerly occurred—requiring the confinement of the patient in an institution—these have entirely ceased to appear.

THE ERADICATION OF GOITER

The importance of maintaining the proper functional activity of a gland as vital to our physical well-being as is the thyroid, cannot be overestimated. The ease with which that may be done makes its neglect inexcusable. The time has now arrived when goiter must be eradicated. Our knowledge of the cause of the disease, its prevention and cure has reached the stage where we can proceed with confidence to that end. Those responsible to the public for the state of the public health, those interested in the betterment of public health are now in a position where, with coöperation, through moderate educational propaganda, they can persuade the public to take for itself the simple step which will insure an adequate iodine supply in the diet to prevent the development of goiter, to arrest the course of the disease where developed, and in the majority of cases to effect cures. By concerted action within a brief period this dread disease may be eradicated—and further honors thus be made to accrue to those who are devoting their lives to disease eradication through preventive medicine.

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For those who wish to read further on this subject, I would refer you to an article on page 23 of September 29th, 1917, Literary Digest, by C. G. Hopkins, entitled "The Ocean's Gift to the Land." Another in September 2nd, 1916, Scientific American, page 215, by Monroe Woolley, entitled "Industrial Preparedness for Peace"—"Obtaining Potash from Kelp." Another in September 21st, 1918, Scientific American, page 231, by Edward Crossman, entitled "Seaweed for War." Still another in May 15, 1915, Scientific American, page 457, entitled "The Pacific Kelp Beds." The Philip R.

Park Company, of Wilmington, California, has probably done more research work on kelp as a food than any other one agency. They have developed a very successful industry and was successfully dehydrating and marketing over 200 tons of kelp per day when I left California. They evolved a very valuable stock food which, in combination with fish meal, was marketed under the trade name of Manimar, and met with pronounced success. The rapid cure of big jaw, goiter and other diseases by this feed attracted wide attention. Tubercular cattle on even a light ration soon showed positive reaction. These results were so conspicuous that this company started research on the use of dried kelp as a human food or natural medicine. Dr. Cavanaugh, the world-renowned chemist from Columbia College, was induced to come to California to assist in this research, the result of which was the development of a concentrated dry kelp in a powder form which is on the market under the trade name of Parkelp, and receiving the endorsement of many of the best medical authorities. Results seem almost unaccountable both as a food and a medicine, and I am almost convinced that kelp serves as a catalectic agency or solvent which increases the assimilability of other foods. Possibly the substance extracted from kelp during the war—"ascetone"—which served as a catalectic agency or solvent to unite the cotton and nitrogen in making explosives, is the miracle agency in making food more available for assimilation.

Another very interesting study is of the preparation of the leafy vegetables so essential for our diet by this improved method of dehydration which removes the water between the cells without breaking the cell wall or oxydizing the product, thus leaving the food value and vitamin content available in a condensed form. The bulk reduction is generally from 15 to 25 to 1—so that they are in most convenient form for storage and shipment and therefore available for convenient use at all seasons and in all parts of the

world. When cooked they are fully equal to the fresh article. Being grown in a highly mineralized section by scientific methods, harvested at exactly the right time and dehydrated the same day, they become one of our most valuable foods. Formerly these vegetables dried in the old-fashioned way were dark and tasteless, with little or no food value available—the valuable mineral content having been consumed by the oxygen of the hot air, leaving a partially decayed surface which set up over-fermentation in the stomach, thereby causing an acid reaction to an otherwise valuable alkaline reactant food. Even fresh vegetables lose their freshness and available food value very soon, even when kept in an ice box. A close microscopic examination will often show oxidation and germs of ferment.

We often put too much confidence in the old-fashioned ice box, which is not infrequently an incubator of disease germs if not carefully guarded. This reminds me of an experience when I was connected with the Good Samaritan Hospital at Los Angeles. One of our most exclusive girls' boarding schools had sent a girl with slight throat trouble for examination and diagnosis of the apparently slight indisposition. We recognized symptoms of diphtheria, so notified our city health office at once and he asked me to accompany him on a trip of inspection to the school. On arrival he proceeded at once to examine the ice box and found the drain choked up with slime; the water leaking through the box had run under the linoleum on the floor, so when stepped on the water oozed up between the cracks. Milk in an open receptacle was examined and germs were found on spinach and lettuce stored in the ice box. On inquiry of why his investigation began with the ice box, Dr. Powers stated that "his years of experience in the health department had shown this to be the most prolific source of trouble." With this in mind, I was one of the first to abandon the ice box in favor of electrical refrigeration in my home.

The Bulletin, "Dental Diseases in Hawaii," by Martha R. Jones, Ph.D., Nils P. Larsen, M.D., and G. P. Pritchard, D.D.S. of Honolulu, is a most valuable record of the careful research work being carried on at the Queen's Hospital in cooperation with the Palama Settlement and the University of Hawaii. The findings are most interesting and clearly show that deficiency of mineral element does exist in the body and traces these through deficiency in the teeth, especially in children of pre-school age. The wonderful teeth and physical strength of the Hawaiian when subsisting principally on vegetables and sea food (including some kelp), as compared with his present condition, after adopting our diet of the highly refined foods, is perfectly apparent. Also the wonderfully perfect teeth of the Japanese when subsisting on their natural diet, which also consisted largely of natural rice, fruit and vegetables, together with sea food in which kelp was a part, as compared with the great deficiency after adopting our highly refined diet—at least in a very large degree. This naturally points to a deficiency in calcium, yet children supplied with milk and food of a high calcium content still showed defective teeth in a marked degree, while the teeth of children whose diet included much fruit and vegetables were uniformly less defective.

Vegetables are so perishable that it is not always possible to procure them in a fresh and perfect state of preservation, and it is also a well-known fact that vegetables grown especially in the tropics are tasteless and do not seem to contain the valuable mineral elements in an assimilable form, therefore there has been an effort made to concentrate vegetables (which are known to contain these valuable elements) into a therapeutic remedy which can be administered as an amendment to our regular diet, and thereby gain the necessary mineral balance in our bodies. I have watched these experiments with growing interest and surprise, for the reaction has oftentimes been entirely

out of proportion. Having obtained an undisputed result, we are now researching to find the cause. Many theories have been advanced and laboratories established to prove or disprove these theories. Mr. L. P. Sims, president of California Vegetable Concentrates, Inc., of Los Angeles, has probably spent more time and money in this research than have all others combined. I have known this man intimately for many years. His high standing and reputation for truth and integrity leads me to quote direct from his personal letter describing this product and explaining his theory, which may or may not solve the mystery of this known phenomenon:

"For the past two years, we have devoted our attention quite exclusively to the production of vegetable concentrates for their therapeutic value. We have learned many things. We have taken every precaution to avoid bacterial infection. We are using only the very best of raw material. As a result of our rather extensive contact with various educational institutions and experimental stations and the personnel thereof, we have learned many things with particular reference to ways and means of avoiding vitamin destruction, particularly the water soluble vitamins. The underlying and basic principle, however, runs directly back to you in your designing of the system of dehydration, which virtually eliminates or avoids oxidation.

"As you know, we have been supplying our products to a number of pharmaceutical manufacturers and to a number of organizations. The use of these products by the pharmaceutical manufacturer with the exception of a few cases, is unknown to us. They are not particularly communicative, relative to their use of our products. On the other hand, the other organizations distributing our products have welcomed the cooperation which we have been in a position to extend, and have been most frank and full in their correspondence. We are therefore familiar in a general way with the veritable

mass of what they termed clinical cases, but which can be more properly described as their 'general practice.' One of the largest distributors of our products, or rather one of the distributors who dispenses the greater volume of vegetable concentrates, dispenses these products in various combinations in a dosage of 10 grains in a capsule. We were advised by these people of the favorable results they secured from this 10-grain dosage. While we knew these gentlemen intimately and well, we have confirmed the reported favorable results through a number of other sources by discussing the subject with various physicians, dispensing these products. Frankly, the therapeutic reactions which they secured are indeed favorable and in many instances quite spectacular. You know just as we do that 10 grains of vegetable concentrates is the residuum of only 150 grains (on the average) of the fresh vegetable. We were satisfied, but confirmed our impression by experiments that 150 grains and even five and ten times 150 grains of the fresh vegetable would produce no apparent physiological reaction whatever. To explain these seemingly paradoxical phenomena, we established a laboratory in conjunction with a clinic which we had previously established under the guidance of our good friend, Dr. D. G. Ragland. The result of this work was what is now being referred to as the 'Sims Theory of Nutrition.' This work, with primary relationship to leafy vegetables, led us to the following conclusions: First, that all of the nutrient values, especially the vitamin potencies and the essential mineral salts, are *within* the cell of the vegetable; second, that the cell walls are of cellulose; third, that cellulose is not broken down by any of the dilute acids or enzymes of the alimentary tract (cellulose is destroyed to some extent by bacterial action in the colon, but of course this is too late for metabolism); fourth, that unless the cellulose cell coverings are broken, cracked or fractured, the nutritional values therein are unavailable for assimilation and me-

tabolism; fifth, that the nutrient values received from the ingestion of vegetables are in direct ratio to the proportion of cellular fracture caused by mastication or other previous preparation; sixth, that the proportion of cellular fracture caused by ordinary mastication is doubtless a very small fraction of 1 per cent; seventh, that complete dehydration renders the vegetable structure extremely brittle and friable and the finest comminution by mechanical impact or other grinding, fractures, cracks and breaks an infinitely greater proportion of cells than is possible by the most prolonged mastication and thus renders available for assimilation and metabolism a vastly increased quantity of auxiliary food factors and essential mineral elements in colloidal form. You will note that this proposition involves quite exclusively the question of comparative cellular fracture.

"As yet we have not reached intelligent conclusions as to the proportion of cellular fracture caused by mastication. Neither have we reached definite conclusions as to the proportions of cellular fracture caused by the finest comminution of the very brittle vegetable structure. Our estimate and present opinion is that the cellular fracture caused by ordinary mastication is an extremely small fraction of 1 per cent. Our estimate of the cellular fracture in the concentrates is approximately 90 per cent. The following statement may appear to you to be rather startling. Granting that the cellular fracture in the concentrate is only 100 times greater than that caused by mastication, it then becomes evident that a level teaspoonful of the vegetable concentrates, weighing approximately 50 grains, is not only equivalent to 750 grains of the fresh vegetable of which it is the residuum, but from the standpoint of availability for assimilation and metabolism, it is equivalent to 100 times 750 grains or 75,000 grains or approximately 10 pounds of the fresh vegetable.

"This theory has been submitted to a score or more of the world's recognized

authorities on nutrition without unfavorable criticism in any instance, but with the urgent suggestion frequently made that metabolism experiments be conducted to conclusively demonstrate the truth of the theory. These metabolism experiments are now being arranged for by a number of recognized authorities, and are already in progress in two or three instances.

"You will note that our work in some degree has been an effort to explain phenomena which already exist.

"Regarding our clinical work, will advise that through the coöperation of a number of physician friends we have completed five formulae, which for the want of better terminology we have temporarily designated as follows:

"CVC—Vegetable Anti-Anemia Food.

"CVC—Vegetable Anti - Constipation Food.

"CVC—Vegetable Anti-Diabetic Food.

"CVC—Vegetable Blood Food.

"CVC—Vegetable Nerve Food.

"We can describe these formulas and the basic reason for them briefly as follows: Anti-Anemia Food is composed of beet leaves, endive, lettuce, spinach, turnip leaves and watercress; all prolific sources of chlorophyl as a foundation-building material for hemoglobin formation. The proportions used were determined to give an optimum balance and calcium, phosphorus and iron. It is noted that spinach, turnip leaves and watercress are outstanding sources of Vitamin A potency. In all secondary and alimentary anemias the blood picture shows a low hemoglobin and low calcium, phosphorus and iron. This food simply supplies in an assimilable form the mineral elements evidently deficient and chlorophyl in abundance. The relationship and necessity of Vitamin A to blood platelet formation is now recognized by all authorities. The use of this formula in the treatment of alimentary and secondary anemias has been uniformly and quite startlingly favorable. It may be of interest to you to have before you what properly might be termed more authoritative information on this subject,

and we respectfully refer you to the work of Dr. Wm. Weston, of the South Carolina Food Research Laboratory, as reported by him in his article, 'A Newer Conception of Nutrition,' as appears on pages 834 to 837 of the September 20th, 1930, issue of the Journal of the American Medical Association. In this article he discusses the use of spinach concentrate, lettuce concentrate, and carrot top concentrate in the treatment of alimentary anemia in nursing infants and lactating mothers. We quote from this article (page 836) as follows: 'In every case of alimentary anemia in which this spinach concentrate has been used, there has been a steady improvement, and in a large number of cases the increase in hemoglobin has been spectacular. This material has also been fed to anemic lactating mothers, whose babies were anemic and the milk insufficient to supply the baby's requirements. In such cases the hemoglobin of the mother and of the baby rapidly improved and the milk supply was increased.' He further states: 'From a limited experience, I believe that carrot top concentrate and lettuce concentrate possess an equal and under certain circumstances a superior food value to spinach concentrate.' In his summary, item 4, Dr. Weston uses rather forceful language. He states, 'the mineral content of the milk should be improved by adding spinach concentrate, lettuce concentrate or carrot top concentrate in suitable proportions to all milk, regardless of the baby's age, if the hemoglobin is below 75 per cent.'

"Anti-Constipation Food consists entirely of asparagus, parsley, okra, the stalk of rhubarb, Irish moss and mint. This food is compounded with respect to the demulcent properties of okra and Irish moss, the Vitamin B potency of asparagus, rhubarb and parsley and the fact that our clinical work has quite conclusively demonstrated that parsley and asparagus apparently perform the function of so altering the colonic flora as to greatly diminish the B. Coli count, reduce the

toxic or inflamed condition of the colon, as well as induce normal peristalsis.

"The Blood Food consists of beet leaves, kale, stalk of rhubarb, turnip leaves, parsley and watercress. The calcium and magnesium contents of this formula are particularly high, with an optimum balance of phosphorus and iron. These vegetables are highly potent in Vitamins A, B (F and G) and C. Beet leaves and parsley, with the other ingredients in smaller proportions has uniformly effected remarkable increases in the leucocyte count from the subnormal, and apparently has increased the phagocytic activity as evidenced by an increased ability of the polymorphonuclear cells to ingest bacteria. While we are not positive, we believe that this is an original discovery of a food which apparently increases the white blood count.

"The Anti-Diabetic Food consists of asparagus, beet leaves, cauliflower, lettuce, spinach, tomato and watercress, all of low carbohydrate content, but forming a prolific source of mineral elements. These vegetables are prolific sources of Vitamins A and B, and we quote Dr. Sherman, of Columbia, in saying 'there is considerable evidence of the relation of Vitamin B to the proper functions of the digestive tract.' In every clinical case under our observation and a number of cases reported to us from cooperating physicians, the use of these vegetables has resulted in a lowering of the sugar and apparently increasing the sugar tolerance. In this food the phosphorus content was, of course, given primary consideration.

"The Nerve Food consists of lettuce, endive, pumpkin, celery, and sea lettuce. Sea lettuce is used as a source of iodine. The other vegetables are of high Vitamins A and B potency, and we believe it is generally recognized that Vitamin B plays an important part in the treatment of those conditions characterized by nerve cell depletion. This is evidenced by the peripheral neuritic forms of beri-beri, when the diet is restrained to those foods

deficient in Vitamin B. You will probably recall that lactucarium is an active principle of both lettuce and endive, and is regarded as a soporific sleep inducement and so used extensively in France at this time.

"In a general way, we call your attention to the fact with which you have doubtless been long familiar, that the human race has subsisted from the beginning of time exclusively on vegetables, either directly or indirectly, through the meat of herbivorous animals or through fish, which in the last analysis live on vegetation. Vegetable concentrates of maximum cellular fracture simply provide these essentials in greater volume by virtue of their greater cellular fracture.

"There is much evidence, Dr. Hulse, to sustain each one of the above numbered statements in our theory above quoted, and likewise there is much evidence to prove that the cooking of vegetables not only destroys or diminishes the vitamin potency, but distinctly diminishes, and, what is more important, alters the mineral salt content of vegetables. From a therapeutic standpoint it therefore appears essential or at least advantageous that the vegetables should be raw. The extremely fine particle size presents an enormously increased surface area for the action of the digestive juices.

"In our theory we have not overlooked the probability of osmotic action or hydrolysis, but our experiments indicate that in the time available in the passage of food through the body, this action is extremely limited. We are pleased to say that a new sales corporation has just been formed here in Los Angeles, under the name of Protective Foods, Inc., for the distribution of the five formulae which we have mentioned above, and subsequently two additional formulae, which are now in process of clinical demonstration, one of which we have temporarily designated as a ration for the expectant and nursing mother and the second as an anti-rheumatic food."